To: State of Michigan
From: Rebecca Stanfield, Senior Energy Policy Advocate, NRDC Midwest Program
Date: 4.22.13

Q7: What are the related cost and benefits (re: affordability, reliability, and the environment) of a range of possible energy efficiency standards (including maintaining our current standard, and increasing it to various levels)?

Summary

Data provided by Consumers Energy and Detroit Edison in their most recent energy optimization plan filings suggest that the state's current efficiency requirements – to achieve incremental annual energy savings of 1% each year – will generate on the order of $600 million in *net* economic benefits (over $800 million in benefits compared to less than $200 million in costs) to the state in *each year* covered by the plans (i.e. through 2015). That is a very conservative estimate because it only values the effects efficiency programs have on the amount of electricity consumed and the amount of new power plants that need to be built to meet peak demand. It does not take into account the value of improved reliability (and related reductions in the cost of investments in the transmission and distribution of electricity) or the environmental benefits of efficiency. As the summary table below shows, when those additional benefits are taken into consideration, the net economic benefit to the state would be on the order of $1.1 billion – *each and every year the requirements are in effect*.

All available evidence suggests that substantial additional benefits could be realized by increasing the utilities' efficiency program investments. Indeed, if Michigan were to increase the electric utilities annual energy savings requirement to 2% per year – a level currently being achieved by other leading states – the net benefits to the state would increase by roughly $550 million per year to more than $1.6 billion. Again, that is the net benefit from just one year's worth of efficiency programs. In other words, if utility efficiency programs were run for five years at that level, the net economic benefits to the state would be on the order of $8 billion.

Table Q7-1: Net Annual Economic Benefits from Electric Utility Energy Savings Requirements

	1% Annual Savings Requiremt (million $)	2% Annual Savings Requiremt (million $)
Benefits		
Avoided Energy and New Generating Capacity Investments	$820	$1,427
Avoided Transmission and Distribution Investments	$65	$114
Carbon emission reduction benefits	$375	$653
Total	$1,260	$2,193
Costs	$192	$576
Net Benefits	**$1,069**	**$1,618**

Avoided Energy and New Generating Capacity Investments

Energy efficiency investments provide a wide array of economic benefits. The two most commonly quantified – and the only two quantified to date by Michigan's electric utilities – are avoided energy expenditures and avoided investments in new generating capacity (i.e. power plants).

Currently, Michigan's electric utilities are required by law to achieve incremental annual electric savings equal to 1% of annual electric sales. In their recent efficiency program plan filings, both Consumers Energy and Detroit Edison have demonstrated that the efficiency programs that they will be running through 2015 to meet those requirements are extremely cost effective, providing roughly $4 in just avoided energy consumption and reduced investments in new power plants for every $1 in efficiency program spending.[1] Together they are planning to spend a little over $150 million a year on electric efficiency. Thus, as shown in more detail in Appendix A, they are currently generating more than $650 million in benefits to the state each year. Extrapolating to the rest of the state (Consumers and DTE serve only about 80% of the

[1] Consistent with Michigan law, both Consumers Energy and DTE assess the cost-effectiveness of their efficiency programs using the Utility Cost Test (UCT). The UCT compares all of the electric system benefits to all of the expenditures that the utility makes to generate those benefits. This is analogous to the way that power plant and/or other "supply-side" investments are considered by utilities and regulators. It is also the framework we use in this document to estimate benefits, costs and net benefits. Note that this approach does not capture either any additional costs to acquire efficiency measures that are born by program participants or any of the additional benefits – such as improved comfort, increased building durability, improved aesthetics, improved business productivity, etc. – that program participants receive. A variety of studies have demonstrated that such non-energy benefits are often of equal or greater value than the energy benefits themselves (see Neme, Chris and Marty Kushler, "Is it Time to Ditch the TRC? Examining Concerns with Current Practice in Benefit-Cost Analysis," published in the *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, 2010.)

state) yields benefits of more than $800 million. Again, that is just for one year of running efficiency programs; the benefits over five or ten years would be $4 and $8 billion, respectively.[2]

As shown in more detail in Appendix B, if the state's annual electric savings requirement were doubled to 2% of electric sales, the value of energy savings and reduced investments in new power plants alone would increase to more than $1.4 billion. That estimate may be conservative for a couple of reasons. First, despite the fact that the state's electric utilities have historically exceeded every annual savings target and are planning to continue to do so for as far into the future as they have planned (i.e. 2015), we assume that the utilities will only just barely meet a 2% savings target. Second, we have assumed that every additional MWh of electric savings is worth about the same as each MWh generated today by the Michigan utilities' programs. That too may be a conservative assumption because the states currently achieving 2% per year savings are doing so with mixtures of programs and measures that are a little longer-lived than is the case with the Michigan utilities' plans for the next few years.[3]

Avoided Transmission and Distribution (T&D) System Investments

Another important benefit of efficiency programs is that, by reducing loads across the system, they can defer the need to invest in upgrades to the transmission and distribution (T&D) system. To be sure, not all "poles and wires" investments can be deferred. Some are needed simply to replace old equipment. However, some will be needed to address load growth.[4] Such growth-related investments can be deferred by system-wide efficiency programs. For example, Con Edison, the utility serving New York City, has estimated that its system-wide efficiency programs have reduced its projected T&D capital expenditures by more than $1 billion after separately adjusting 10-year load forecasts for each of its 91 distribution networks and load

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[2] Only the energy and power plant benefits of efficiency programs are discussed in this section. Other benefits are discussed in ensuing sections. The costs of achieving all of the benefits of efficiency are discussed immediately after all the last benefits section. That makes it easier to compare the sum of all benefits to the costs. That said, for those who wish to compare just the energy and power plant investment savings to the costs of the programs (consistent with the Consumers' and DTE regulatory filings), such comparisons can be found in Appendix A (For the current plans) and Appendix B (for a more aggressive energy savings target). As those appendices show, even compared to just energy and power plant investment savings, both the current utility 1% per year savings requirements (net benefits of over $600 million) and a more aggressive 2% per year savings requirement (net benefits on the order of $850 million) are very cost-effective.

[3] For example, the weighted average measure life of the savings forecast for 2013 by Consumers and DTE is almost exactly 10 years. In contrast, Efficiency Vermont's 2012 efficiency programs, which collectively produced savings on the order of 2% of sales, had an average measure life of a little more than 11 years. Similarly, NSTAR, a Massachusetts utility planning to achieve savings of more than 2.5% of sales in 2013, is forecasting an average measure life of more than 12 years.

[4] Even if jurisdictions in which total loads are not growing, there are often pockets where load is growing (and others where it is declining).

areas.[5] Similarly, the New England Independent System Operator recently concluded that system-wide efficiency programs in the rural states of Vermont and New Hampshire has led to the deferral (beyond 2020) of "ten upgrades of transmission lines and other equipment" at a cost savings to the region of $260 million.[6] If such benefits are being realized from the densely populated city of New York to the rural reaches of northern New England, they are almost certainly being realized in Michigan as well. They just haven't been quantified.

In a variety of other states, utilities now routinely assess the cost-effectiveness of efficiency programs using not only values for energy savings and deferring the need for new power plants, but also for deferring T&D upgrades. In New England, utility estimates of avoided T&D costs have ranged from about $55 to $120 per kW-year. Estimates for several utilities in California and the Pacific Northwest have ranged from $30 to $105 per kW-year, with an average of close to $50 per kW-year.[7] Commonwealth Edison, the utility serving the Chicago area, has just estimated its avoided T&D costs to be $42/kW-year.[8] For the purposes of this document, we have assumed that the avoided T&D cost for Michigan is $40 per kW-year. At that value, the current portfolio of Michigan efficiency programs can be estimated to provide $65 million per year in T&D deferral benefits. At a 2% per year savings requirement, the annual benefits would increase to approximately $114 million (see Appendix C for more details).

Environmental Emission Reductions Benefits

In addition to the direct economic benefits to the electric system, energy efficiency investments provide substantial environmental benefits. By reducing the amount of coal, gas, oil and other fuels burned to produce electricity, efficiency reduces air emissions of carbon dioxide (CO_2), the pollutant most responsible for global climate change, as well sulfur dioxide, nitrous oxides, mercury and other air toxics. It also reduces water pollution and the amount of solid waste that requires disposal. For this document, we have quantified only the CO_2 benefits.

More than 70% of the electricity consumed in Michigan is generated by burning coal,[9] the most carbon-intensive fossil fuel. Moreover, according to the Midwest Independent System Operator, coal-fired power plants are almost always at the margin – setting the market clearing

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[5] Gazze, Chris and Madlen Massarlian, "Planning for Efficiency: Forecasting the Geographic Distribution of Demand Reductions," in *Public Utilities Fortnightly*, August 2011, p. 36-41.
[6] George, Anne and Stephen Rourke (ISO New England), "ISO on Background: Energy Efficiency Forecast", power point presentation on December 12, 2012 (see: http://www.iso-ne.com/nwsiss/pr/2012/ee_forecast_final_12122012_post.pdf)
[7] Neme, Chris and Rich Sedano, "U.S. Experience with Efficiency as a Transmission and Distribution System Resource", published by the Regulatory Assistance Project, February 2012 (see: www.raponline.org)
[8] Personal communication with Roger Baker, Commonwealth Edison, April 16, 2013.
[9] U.S. Environmental Protection Agency, eGRID2012 (Emissions & Generation Resource Integrated Database) Version 1.0: Year 2009 Summary Tables, created April 2012 (see: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf)

price for electricity in the region 93% of the time.[10,11] As a result, the non-baseload CO_2 emission rate for Michigan is estimated to be a relatively high 1835 pounds of CO_2 per MWh.

At that rate, and assuming the Michigan utilities' current average efficiency measure life of 10 years,[12] one year of efficiency program implementation to meet the current savings requirement will reduce CO_2 emissions by 10.7 million tons over the life of the measures installed that year. If the savings requirement was increase to 2% per year, the lifetime CO_2 emission reductions for each year of efficiency program implementation would be 18.7 million tons.

A variety of different jurisdictions have used different approaches to estimate the value of CO_2 emission reductions. In some jurisdictions, a single reference case value has been estimated. Other jurisdictions have developed three different values – a low, a mid/reference and a high case. A recent summary of such work suggests that the mid or reference cases for more than twenty different utilities ranged from $20 to $50 per ton on a levelized cost basis.[13] If the mid-point of that range - $35/ton – is used, the value of the CO_2 emission reductions from just one year of Michigan's electric efficiency programs would be approximately $375 million under the current 1% annual savings requirement. It would increase to about $650 million if the requirement was increase to 2% per year.

Sum of All Quantified Benefits

Each of the benefits of continued pursuit of efficiency programs in Michigan described above is substantial. Taken together, they are enormous. As Table 2 shows, just continuing the current requirement to achieve 1% savings each year would yield on the order of $1.3 billion in benefits. Increasing the requirement to 2% per year increases the benefits to roughly $2.2 billion. Again, that is for just one year of efficiency program implementation. The value from five years of such programs would be over $6 billion under current requirements and roughly $11 billion under a 2% annual savings requirement.

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[10] The resource at the margin is generally the resource whose operation efficiency savings will reduce or eliminate.
[11] Potomac Economics (Independent Market Monitor for MISO), "2011 State of the Market Report for the MISO Electricity Markets", June 2012.
[12] This is a weighted average for Consumers (11.1 years) and DTE (9.1 years) based on measure level data provided by both utilities in recent regulatory proceedings (U-17138 and U-17049).
[13] Woolf, Tim et al. (Synapse Energy Economics, Inc.), *Energy Efficiency Cost-Effectiveness Screening: How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs*, published by the Regulatory Assistance Project, November 2012

TableQ7- 2: Total Annual Economic Benefits from Electric Utility Energy Savings Requirements

	1% Annual Savings Requiremt (million $)	2% Annual Savings Requiremt (million $)
Avoided Energy and New Generating Capacity Investments	$820	$1,427
Avoided Transmission and Distribution Investments	$65	$114
Carbon emission reduction benefits	$375	$653
Total	**$1,260**	**$2,193**

Moreover, there are important additional benefits that we have not quantified. These include the electricity price suppression effects of efficiency (sometimes referred to as demand reduction induced price effects, or DRIPE), marginal (rather than average) line losses, risk mitigation,[14] and reductions in emissions of pollutants other than carbon.

Of course, to understand the true value of efficiency investments one must understand the costs as well as the benefits. As discussed below, the costs that would need to be incurred to achieve the savings levels discussed in this document, though substantial, are considerably smaller than the resulting benefits.

Costs of Achieving Savings/Benefits

Consumers Energy and Detroit Edison have already provided estimates of the costs of achieving (indeed, exceeding) a 1% annual savings target over the next few years. When extrapolated to the entire state, they are on the order of $200 million per year. That translates to a levelized cost of about 2.2 cents/kWh saved.[15]

To develop an estimate of the cost of achieving a 2% savings level we looked to the experience of Efficiency Vermont, a state that has actually averaged 2% savings per year over the past five years. Using Efficiency Vermont's 2012 cost per kWh we estimate that it would cost Michigan approximately $575 million to achieve a 2% annual savings target. Efficiency Vermont estimates that it produced savings at a levelized cost of 3.4 cents/kWh saved.[16]

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[14] For example, efficiency investments reduce exposure to fuel price volatility and forecasting inaccuracies. It is worth noting that the Vermont regulators have required that cost-effectiveness screening of efficiency programs include a 10% reduction to the costs of the efficiency (an alternative to adding a 10% adder to the benefits) to assign value to efficiency's risk mitigating benefits.

[15] Using the Michigan utilities' average measure life of 10 years and a real discount rate of 6% (derived from Consumers Energy's nominal discount rate of 8.7% adjusted for assumed 2.5% inflation).

[16] It appears as if that calculation used a slightly lower real discount rate (5%) than we have assumed for Michigan (6%). If the higher discount rate was used, the levelized cost would increase to 3.6 cents/kWh.

There are several reasons to believe that may be a conservatively high estimate for Michigan. First, Vermont is a small state with low population density, offering less economy of scale in the delivery of efficiency programs than would be possible in Michigan. Second, Efficiency Vermont is required to spend more on low income programs, which typically yield much lower savings per dollar, than the Michigan utilities are spending on such programs.[17] Third, compared to Michigan, Vermont has relatively little access to natural gas, reducing potential for cost savings from joint electric–gas programs. Fourth, Efficiency Vermont intentionally invests in programs that provide very modest electric savings in order to leverage savings in unregulated fuels, such as oil and propane, which most Vermonters use to heat their homes and businesses. Finally, and perhaps most importantly, baseline efficiency levels in Vermont are higher than in Michigan, so there is less inexpensive savings available to acquire. The one disadvantage that Michigan might have – in terms of making it easier or less expensive to acquire efficiency savings – is that its electric rates are about 15-20% lower than Vermont's, providing less financial incentive for customers to invest in efficiency. However, that disadvantage is likely to be outweighed by the competitive advantages discussed above.

Net Benefits of Future Michigan Electric Efficiency Savings Requirements

The bottom line is that continuing Michigan's current annual savings requirement of 1% per year would produce net economic benefits to the state of over $1 billion – *each and every year*. Increasing the savings requirement to 2% per year would increase the annual net economic benefit to the state by about $550 million to over $1.6 billion per year.

We have not directly assessed the benefits, costs and net benefits of levels of savings between the current statutory requirement of 1% per year and the much more aggressive 2% per year levels currently being achieved and/or planned in several leading states. In general, we would expect that the benefits for savings levels in between could be linearly interpolated. In other words, the benefits for a 1.5% target would likely be roughly equal to the mid-point between the benefits at the current 1% level and the more aggressive 2% level. On the other hand, we would expect the costs of a 1.5% savings target to be a little less than the mid-point between our estimated costs for the 1% and 2% levels because costs tend to increase non-linearly.

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[17] Efficiency Vermont spent 14% of its 2012 budget on low income programs. In contrast, Detroit Edison is estimating it will spend 9% of its 2013-2015 budget on low income programs (testimony of Vicki Campbell, Exhibit A-4, in U-17049); Consumers Energy is forecasting it will spend only 6% of its electric efficiency portfolio budget on low income programs from 2012-2015 (Consumers Energy, 2012-2015 Amended Energy Optimization Plan, submitted to the Michigan Public Service Commission, Case No. U-16670, August 1, 2011).

Appendix A: Annual Benefits & Costs of Michigan Utilities' Current 1% Annual Electric Savings Requirement
(energy and peak power plant capacity benefits only)

Consumers Data from 2012-2015 Plan

Year	Energy Savings (MWh)	Energy Savings (% Sales)	Peak Savings (MW)	Spending (million $)	Benefit-Cost Ratio	Benefits (million $)	Net Benefits (millions $)
2012	393,281	1.18%	n.a.	$67.6			
2013	407,718	1.21%	76.8	$69.2			
2014	409,598	1.20%	80.4	$71.9			
2015	424,941	1.23%	84.0	$73.8			
Total	1,635,538	1.20%	241.2	$282.5	3.9	$1,101.8	$819.3
Avg	408,885	1.20%	80.4	$70.6		**$275.4**	**$204.8**

Sources: Consumers Energy: 2012-2015 Amended Energy Optimization Plan, submitted to Michigan Public Service Commission, Case No. U-16670, August 1, 2011; peak savings from settlement agreement in U-17138

DTE Data from 2013-2015 Plan

Year	Energy Savings (MWh)	Energy Savings (% Sales)	Peak Savings (MW)	Spending (million $)	Benefit-Cost Ratio	Benefits (million $)	Net Benefits (millions $)
2013	519,120	1.10%	95.0	$76.3			
2014	533,608	1.11%	99.3	$85.0			
2015	541,435	1.12%	100.6	$87.8			
Total	1,594,163	1.11%	294.9	$249.1	4.6	$1,145.9	$896.8
Avg	531,388	1.11%	98.3	$83.0		**$382.0**	**$298.9**

Source: Testimony of Vicki Campbell, Exhibit A-4 and DTE response to NRDC data request 31 in U-17049.

Estimated Statewide Benefits (extrapolating from CE & DTE)

	Energy Savings (MWh)	Energy Savings (% Sales)	Peak Savings (MW)	Spending (million $)	Benefit-Cost Ratio	Benefits (million $)	Net Benefits (millions $)
CE/DTE Combined Avg	940,272	1.15%	178.7	$153.7	4.3	$657.4	$503.7
CE/DTE % of State Sales	80%						
Statewide Benefits	1,172,409	1.15%	222.8	$191.6	4.3	**$819.7**	**$628.1**

Notes

1 Estimate of % of state's sales that are from Consumers Energy and DTE from U.S. EIA's *Electric Sales and Revenue 2011*

Appendix BAnnual Benefits & Costs of Increasing Michigan's Annual Electric Savings Requirement to 2%
(energy and peak power plant capacity benefits only)

	Energy Savings (MWh)	Energy Savings (% Sales)	Peak Savings (MW)	Spending (million $)	Benefit-Cost Ratio	Benefits (million $)	Net Benefits (millions $)
Current MI Law	1,172,409	1.15%	222.8	$191.6	4.3	**$819.7**	**$628.1**
Benefits of 2%	2,040,418	2.00%	387.8			**$1,426.6**	
Cost of 2% Requirement				$575.8			
Increase in Net Benefits of 2% Requirement							**$222.7**
Net Benefits of 2% Requirement							**$850.8**

Notes:

1 Benefits of achieving 2% annual savings are assumed to be the same per first year kWh saved as under current law. This is likely a conservative assumtion as the average measure life of jurisdictions achieving 2% is a little longer than the current Michigan utilities' plans.

2 The cost of achieving 2% annual savings is based on the cost of Efficiency Vermont's 2012 efficiency porfolio, which costs approximately 70% more per first year kWh saved than the current Michigan utilities' portfolios. That is likely a conservatively high estimate for several reasons: (A) Vermont is a smaller and less densely populated state, offering less economy of scale in program costs than should be possible in Michigan; (B) Efficiency Vermont is required to spend more on expensive low income program savings (14% of total spending in 2012) than is current spent in Michigan (6-10%); (C) Vermont has relatively little access to natural gas, reducing potential for cost savings from joint delivery of electric and gas efficiency programs; (D) Efficiency Vermont intentionally invests in programs that provide very modest electric savigns in order to leverage savings in unregulated fuels (e.g. oil and propane) which most Vermonters use to heat their homes and businesses; and, probably most importantly, (E) baseline efficiency levels in Vermont are higher - in other words, there is less "low hanging fruit" remaining - because the state has been pursuing efficiency for much longer (more than 20 years) and more aggressively than Michigan. The one disadvantage of pursuing efficiency in Michigan, relative to Vermont, is that the electric rates are a little lower (15-20% lower when comparing the largest utilities in both states), providing less financial incentive for consumers to consider upgrades. However, that disadvantage is likely to be significantly outweighed by the comparative advantages referenced above.

Appendix C: Value of Michigan's Transmission & Distribution System Savings from Efficiency Programs

Assumed value of T&D Savings	$40	per kW-Year
Annual Statewide Peak Demand Savings under Current MI Law	222.8	MW
Average life of energy savings	10.0	Years
Real discount rate	6.0%	
NPV of annual T&D Savings under Current MI law	**$65**	Million $
NPV of additional annual T&D savings under 2% annual savings requirement	$48	Million $
NPV of total annual T&D savings under 2% annual savings requirement	**$114**	Million $

Notes:

1 Value, per kW-year, of avoided T&D costs is on low end of values used in states that have assessed such benefits.

2 Average annual life of savings based on analysis of Consumers and DTE planned mix of measures and programs

3 Real discount rate of 6% based on Consumers nominal rate of 8.7%, adjusted for assumed 2.5% inflation rate.

Appendix D: Annual CO2 Emission Reduction Benefits from Future Michigan Efficiency Requirements

	1% Annual Savings Requiremt	2% Annual Savings Requiremt
Annual Emission Reductions from One Program Year (Millions of Tons)	1.1	1.9
Lifetime Emission Reductions from One Program Year (Millions of Tons)	10.7	18.7
Value of Emission Reductions from One Program Year (millions $)	**$375.3**	**$653.2**

Notes:

1 Annual emission reductions estimates based on assumed marginal emission rate of 1835 lbs/MWh from the U.S. Environmental Protection Agency's eGRID2012. Data are for 2009 for non-baseload output.

2 Lifetime emission reductions are annual reductions multiplied by the average life of the efficiency measures installed. A weighted average measure life of 9.97 years is based on measure level data provided by Consumers Energy and DTE in their 2012-2015 plans.

3 CO2 emission reductions valued at an assumed levelized cost of $35/ton - the mid-point in the range used in more than 20 utility IRPs across the country (see Woolf, Tim et al. (Synapse Energy Economics, Inc.), *Energy Efficiency Cost-Effectiveness Screening: How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs* , published by the Regulatory Assistance Project, November 2012).